

MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
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SRM Number: 3158
MSDS Number: 3158
SRM Name: Thallium Standard Solution

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Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of thallium. Each unit consists of five 10-mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of thallium. The solution contains nitric acid at a volume fraction of approximately 10 %.

Material Name: Thallium Standard Solution

Other Designations:

Thallium: Tl; elemental thallium; ramor.

Thallium Nitrate: Thallium mononitrate; thallium (1+) nitrate; nitric acid, thallium salt.

Nitric Acid: Aqua fortis; hydronitrate; azotic acid; engraver's acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Nitric Acid	7697-37-2	231-714-2	10
Thallium Nitrate	10102-45-1	233-273-1	1.91
Thallium	7440-28-0	231-138-1	1

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 4 Fire = 0 Reactivity = 2

Major Health Hazards: Nitric acid can cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. Thallium and its compounds are highly toxic and may cause severe illness or death.

Physical Hazards: Glass container may break or shatter.

Potential Health Effects

Inhalation:	Nitric acid can damage the mucous membranes and respiratory tract, causing spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Teeth may also be damaged. Inhalation of thallium nitrate and other water-soluble thallium compounds may cause cumulative poisoning, resulting in pulmonary edema and alveolar damage. The central nervous system may also be affected (see Ingestion). Inhalation of insoluble thallium dust may irritate the upper respiratory tract.
Skin Contact:	Nitric acid can cause severe skin burns. Effects of acid burns may be delayed. Skin contact with thallium or its compounds may cause irritation and dermatitis. Thallium nitrate may cause death if absorbed through the skin.
Eye Contact:	Nitric acid can cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Thallium and its compounds may cause eye irritation and conjunctivitis.
Ingestion:	Nitric acid can cause severe burns and damage to the GI tract. Water-soluble thallium compounds are cumulative poisons that may cause severe illness or death by ingestion, inhalation, or absorption. Ingestion of thallium nitrate may cause a metallic taste in the mouth, followed by nausea, vomiting, diarrhea, and abdominal pain. Other warning signs may include muscle pain and weakness, weight loss, hair loss, disorientation, tremors, restlessness, and slurred speech. Mental disturbances, convulsions, and psychosis may follow. Bleeding in the GI tract may occur several days later, with circulatory collapse, respiratory failure, coma, and death. Liver and kidney damage and endocrine disorders may also occur. Like other nitrates, thallium nitrate may also cause methemoglobinemia (an abnormal condition of the blood), with cyanosis, convulsions, and breathing difficulty.

Medical Conditions Aggravated by Exposure: Pre-existing disorders of the eyes, skin, respiratory tract, GI tract, liver, kidneys, central nervous system, or other target organs.

Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens	_____	<u> X </u>
In the International Agency for Research on Cancer (IARC) Monographs	_____	<u> X </u>
By the Occupational Safety and Health Administration (OSHA)	_____	<u> X </u>

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. If not breathing, qualified personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Flush affected skin with water for at least 15 minutes, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

Note to Physician (Nitric Acid): Wash affected skin with 5% solution of sodium bicarbonate (NaHCO_3). Activated charcoal is of no value. Do not give bicarbonate to neutralize the material.

Note to Physician (Thallium): Hemodialysis or hemoperfusion may reduce thallium concentrations in blood. Oral or duodenal administration of Prussian blue (potassium ferric ferrocyanide) may help prevent absorption of thallium.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Nitric acid is a powerful oxidizing agent that can react with combustible materials to cause fires. Thallium nitrate is also a strong oxidizing agent. No data are available for the mixture, and its behavior may differ from that of the individual components.

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. Use a water spray to dilute nitric acid and to absorb liberated oxides of nitrogen. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Lower Explosive Limit (LEL): N/A

Upper Explosive Limit (UEL): N/A

Flammability Class (OSHA): N/A

6. ACCIDENTAL RELEASE MEASURES

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Disposal: Refer to Section 13, Disposal Considerations.

7. HANDLING AND STORAGE

Storage: Store unopened containers of this material in a dry place at room temperature. Protect from physical damage, heat, and light, and isolate from incompatible materials. Use opened containers immediately or discard.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). If contact with this material occurs, wash hands or change clothing as required. Engineering controls should maintain airborne concentrations below TLV (Section 8).

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Nitric Acid:

ACGIH TLV-TWA: 2 ppm or 5 mg/m³

OSHA TLV-TWA: 2 ppm or 5 mg/m³

UK WEL: 5.2 mg/m³

Thallium Nitrate (limits for water-soluble thallium compounds):

ACGIH TLV-TWA: 0.1 mg/m³

OSHA TLV-TWA: 0.1 mg/m³

UK WEL: 0.1 mg/m³

Thallium (elemental Tl, not water-soluble):

OSHA TLV-TWA: None established. Total nuisance dust, 15 mg/m³; respirable dust, 5 mg/m³

ACGIH TLV-TWA: None established. Total nuisance dust, 10 mg/m³; respirable dust, 3 mg/m³

UK WEL: None established. Total inhalable dust, 10 mg/m³; respirable dust, 4 mg/m³

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

Nitric Acid	Thallium Nitrate	Thallium
Appearance and Odor: Colorless to slightly yellow liquid, darkens to brown upon aging and exposure to light; irritating, pungent odor.	Appearance and Odor: Colorless to white crystals, no odor	Appearance and Odor: White or blue-white metal or crystals, no odor
Relative Molecular Weight: 63.02	Relative Molecular Weight: 266.39	Relative Molecular Weight: 204.38
Molecular Formula: HNO ₃	Molecular Formula: TlNO ₃	Molecular Formula: Tl
Specific Gravity: 1.0543 (10%)	Specific Gravity: 5.55	Specific Gravity: 11.85
Solvent Solubility: Decomposes in alcohol	Solvent Solubility: Soluble in acetone; insoluble in alcohol	Solvent Solubility: Soluble in nitric acid and sulfuric acid
Water Solubility: Soluble	Water Solubility: Slightly soluble	Water Solubility: Insoluble
Boiling Point (°C): 86 (187°F)	Boiling Point (°C): 430 (806°F)	Boiling Point (°C): 1457 (2655°F)
Melting Point (°C): -42 (-43.6°F)	Melting Point (°C): 206 (403°F)	Melting Point (°C): 303.5 (578°F)
Vapor Pressure (Pa): 946 @20°C	Vapor Pressure (Pa): N/A	Vapor Pressure (Pa): Negligible
Vapor Density (Air=1): 2.17	Vapor Density (Air=1): N/A	Vapor Density (Air=1): N/A
Critical Solution Temperature: N/A	Critical Solution Temperature: N/A	Critical Solution Temperature: N/A
pH: 1.0 (0.1M solution)	pH: N/A	pH: N/A

NOTE: The physical and chemical data provided are for the pure components. Physical and chemical data for this solution do not exist. The actual behavior of the solution may differ from the individual components.

10. STABILITY AND REACTIVITY

Stability: X Stable Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Combustible materials and other incompatible materials.

Incompatible Materials:

Nitric Acid: Incompatible with numerous materials including organic materials, plastics, rubber, chlorine, and metal ferrocyanide.

Thallium Nitrate: Incompatible with combustible materials and reducing agents.

Thallium: Incompatible with halogens (ignites on contact with fluorine).

Fire/Explosion Information: See Section 5.

Hazardous Decomposition: Thermal decomposition of this material may produce nitrogen oxides (NO, NO₂, and N₂O) and toxic fumes of thallium.

Hazardous Polymerization: _____ Will Occur X Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: X Inhalation X Skin X Ingestion

Nitric Acid:

Human, oral: LD_{Lo} = 430 mg/kg

Rat, oral: LD₅₀ > 90 mg/kg

Rat, inhalation: LC₅₀ (4 hrs) = 130 mg/m³

Thallium Nitrate:

Rat, intraperitoneal: LD₅₀ = 21 µg/kg

Man, oral: TD_{Lo} = 73 mg/kg

Thallium:

Man, oral: TD_{Lo} = 5714 µg/kg

Man, oral: Estimated lethal dose = 15 mg/kg

Target Organ(s): Respiratory tract, skin, eyes, teeth, GI tract, liver, kidneys, central nervous system, cardiovascular system, endocrine system, blood.

Mutagen/Teratogen: Nitric acid has caused birth defects in animals under experimental conditions, and has been investigated as a possible mutagen. Thallium has caused mutations and birth defects in rats.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Nitric Acid, Ecotoxicity Data:

Green shore crab (*Carcinus maenas*): LC₅₀ (48 hrs) = 180,000 µg/L

Starfish (*Asterias rubens*): LC₅₀ (48 hrs) = 100,000 to 330,000 µg/L

Hooknose (*Agonus cataphractus*): LC₅₀ (48 hrs) = 100,000 to 330,000 µg/L

Brook trout (*Salvelinus fontinalis*): NR-LETH = 1,562 µg/L

Thallium Nitrate: No ecotoxicity data found.

Thallium: No ecotoxicity data found.

Environmental Summary: One or more components of this mixture may be toxic to aquatic organisms. Do not release to the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture are a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Nitric Acid Solution, Hazard Class 8, UN2031, Packing Group II

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Nitric Acid: RQ = 1000 lbs.

Thallium Nitrate: RQ = 1000 lbs.

Thallium: RQ = 1000 lbs.

SARA Title III Section 302: All three components are regulated

SARA Title III Section 304: All three components are regulated

SARA Title III Section 313: All three components are regulated

OSHA Process Safety (29 CFR 1910.119): Nitric acid at higher concentrations ($\geq 94.5\%$) is regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: No

REACTIVE: Yes

SUDDEN RELEASE: No

STATE REGULATIONS

California Proposition 65: No components are regulated.

CANADIAN REGULATIONS

WHMIS Classification:

Nitric Acid: C (oxidizing material), D1A (very toxic material), E (corrosive material)

Thallium Nitrate: D1A (very toxic material), C (oxidizing material)

Thallium: D1A (very toxic material)

WHMIS Ingredient Disclosure List: All three components are regulated.

CEPA Domestic Substances List (DSL): Nitric acid and thallium are regulated.

CEPA Non-Domestic Substances List (NDSL): Thallium nitrate is regulated.

EUROPEAN REGULATIONS

EU/EC Classification:

Nitric Acid: O (Oxidizer), C (Corrosive)

Thallium Nitrate: T+ (Very Toxic), O (Oxidizer); not classified in Annex I of Directive 67/548/EEC

Thallium: T+ (Very Toxic)

Risk Phrases (mixture):

R26/28 (very toxic by inhalation and if swallowed)
R33 (danger of cumulative effects)
R34 (causes burns)
R36/37/38 (irritating to eyes, respiratory system and skin)
R53 (may cause long-term adverse effects in the aquatic environment)

Safety Phrases (mixture):

S20/21 (when using, do not eat, drink or smoke)
S28 (wash after contact with skin)
S45 (in case of accident or illness, see doctor; show label)
S60 (dispose of this material and its container as hazardous waste)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All components are listed.

TSCA 12(b), Export Notification: No components are listed.

16. OTHER INFORMATION

Sources:

Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological Profile for Thallium. July 1992.

Hazardous Substances Data Bank (HSDB): Thallium and Thallium Compounds.

PAN Pesticide Database: Nitric Acid.

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, September 2005 edition. DHHS (NIOSH) Publication No. 2005-151.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.